maintain the department of street cleaning. In no other comparable city in the civilized world is this question in such unsatisfactory shape or so difficult to cope with, under the practical conditions which exist, as in the metropolitan district which we are considering.

The time will come when New York City will insist upon clean streets and find a way to have them. Eventually the public will demand that the refuse from our tables, kitchens and factories shall be disposed of at a minimum of offense and a maximum of economy and despatch. But until this problem is made the subject of competent study and a broad, comprehensive plan of administration and procedure is laid down, we may expect slow improvement in the primitive methods which have always been an offense to the eyes and nose in New York City.

The solution of this problem is probably far beyond the unaided capacity of any person who may be placed at the head of the street-cleaning department, and these remarks, therefore, reflect in no wise upon the ability of any official of the city, past, present or future. If it can be solved at all, and there is a very general impression that it can, the problem can be solved only as the other great sanitary engineering problems of New York have been, and are being, solved. That is, with the help of qualified experts, acting without prejudice, political bias or other ambition than to serve the best interests of the city.

GEORGE A. SOPER

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
SECTION A—MATHEMATICS AND ASTRONOMY

Vice-president—Dr. Edward Kasner, Columbia University, New York City.

Secretary—Professor L. G. Weld, State University of Iowa, Iowa City, Iowa.

Member of the Council—Professor G. B. Halsted, State Normal College, Greeley, Colorado.

Sectional Committee—Dr. Edward Kasner, vice-president, 1907; Dr. W. S. Eichelberger, vice-president, 1906; Professor L. G. Weld, secretary, 1904–1908; Professor Ormond Stone, one year; Professor E. B. Frost, two years; Professor E. O. Lovett, three years; Professor Harris Hancock, four years; Professor A. N. Skinner, five years.

Member of the General Committee—Professor James McMahon, Cornell University, Ithaca, N. Y.

Press Secretary—The secretary of the section.

Professor E. O. Lovett, of Princeton University, was elected vice-president for the year 1908.

The following mathematicians and astronomers were elected to fellowship in the association:

Baker, R. H.,	Maclay, James,
Brown, G. L.,	Manning, H. P.,
Dugan, R. S.,	Olds, G. D.,
Faught, J. B.,	Plimpton, G. A.,
Gates, Fannie C.,	Poor, C. L.,
Glenn, O. E,,	Riggs, N. C.,
Graham, W. J.,	Schultz, L. G.,
Granville, W. A.,	Smith, F. H.,
Hadley, S. M.,	Washburne, A. C.,
Leavitt, Henrietta L.,	Wilson, N. R.,
Lowell, Percival,	Young, Anna S.

The address of the retiring vice-president, Dr. W. S. Eichelberger, entitled 'Clocks, Ancient and Modern,' was presented on the afternoon of Thursday, December 27, in Fayerweather Hall of Columbia University. This address has already been published in SCIENCE for March 22 of the current year.

A joint session of Section A with the American Mathematical Society and the Astronomical and Astrophysical Society of America was held on Friday forenoon, December 28, in Schermerhorn Hall. The chair was occupied by Professor Simon Newcomb, past president of each of the participating societies. This was perhaps the most largely attended and the most generally interesting of any of the meetings in which any of the participating societies had a part. The following program was

presented: numbers 1 and 5 being contributed by the Mathematical Society, 2 and 4 by the Astronomical and Astrophysical Society, 3, 6 and 7 by Section A.

1. *The Rational Basis of Mathematical Pedagogy:* Professor S. E. Slocum, University of Cincinnati.
2. *Photographic Observations of the Milky Way:* Professor E. E. Barnard, Yerkes Observatory.
3. *The Stream Function for a Straight Channel with a Circular Island:* Professor James McMahon.
4. *The Tenth Satellite of Saturn:* Professor W. H. Pickering, Harvard University.
5. *On the Law of Gravitation in the Binary Systems:* Dr. F. L. Griffin, Williams College.
6. *Latitude Terms of Long Period:* Professor C. L. Doolittle.
7. *Dynamical Trajectories:* Dr. Edward Kasner.

Abstracts of 1 and 5 of the above papers appear in the *Bulletin of the American Mathematical Society,* Vol. VIII., pp. 265, 266; of 2, 4 and 6, in the report of the eighth annual meeting of the Astronomical and Astrophysical Society of America, in Science for April 12. The others will be further noticed below.

The full list of papers appearing upon the program of Section A, with such abstracts of the same as are available, is as follows:

An Examination of the Results of Seven Years' Observation with the Zenith Telescope of the Flower Observatory for Latitude Terms of Long Period: Professor C. L. Doolittle, University of Pennsylvania, Philadelphia.

A Preliminary Report on a Solar Rotative Period Investigation: Mr. Philip Fox, Yerkes Observatory, Williams Bay, Wis. The preliminary investigation of the solar rotation period which was made, under Mr. Hale's direction, by measuring calcium flocculi positions on the Kenwood series of spectroheliograms (Science, N. S., XXI., 175), is now being supplemented by a reduction of the measurements of the plates made with the Rumford Spectroheliograph. One hundred of these plates obtained in 1904 give the following results:

ϕ	ξ	Rumford Period	Kenwood Period	$R - K$
° °	°	*d*	*d*	*d*
0 5	14.50	24.82	24.56	+0.26
5 10	14.44	24.93	24.79	0.14
10 15	14.18	25.38	25.02	0.36
15 20	13.92	25.86	25.26	0.60
20 25	13.68	26.32	25.45	+0.87
25 30	13.95	25.80	25.99	−0.19
30 35	13.68	26.31	26.31	0.00
35 40	13.25	27.18		

The periods are thus seen to have been longer in 1904 than in 1893–4–5, the period covered by the Kenwood series. The plates of 1905 and 1906 are about to be measured.

The Retrograde Motion of Phœbe: Mr. A. O. Granger, Philadelphia, Pa. (Read by title.)

The Sect-carrier and the Set-sect: Professor G. B. Halsted, State Normal College, Greeley, Colo.

The school of Plato fixed as the instruments for the solution of geometric problems, the ruler and compasses, the straight line and circle. As in Euclidean geometry the straight line is a circle (of infinite radius) and as Euclid unconsciously made in his very first proposition the 'assumption of the compasses,' that "If a circle have a point within and a point without another circle, it has two points on this other" (Halsted, 'R. Geom.,' VI., 2), the world has had to await the coming of the non-Euclidean geometry to become conscious of the fact that elementary geometry has been carrying a wholly unnecessary 'rider.'

The compasses may be superseded by the simpler 'transferrer of line-segments,' for which the name 'sect-carrier' has been adopted. Thus without the circle or compasses all the problems of elementary geometry are solved in the first edition of Halsted's 'Rational Geometry.' But a remarkable additional simplification has now been achieved, and this paper makes public for the first time the simple demonstration which makes it available for the elements of geometry. This advance is the substitution of the set-sect for the sect-carrier. The transference of only a single sect need be assumed for the solution of all the problems of elementary geometry. Consequently the power to take a centimeter on a given straight line is found to be assumption enough to supersede the circle, the compasses, and even the sect-carrier. Nothing now is needed but a ruler and a set-sect.

On a Fundamental Theorem of Weierstrass by Means of which the Theory of Elliptic Functions may be Established: Professor HARRIS HANCOCK, University of Cincinnati, Cincinnati, O.

The theorem in question is stated by Weierstrass in the 'Theorie der Abelschen Functionen' (*Crelle's Journ.*, bd. 52, § 7; and 'Math. Werke,' bd. I., p. 349).

By means of his theorem it may be shown that the p-function may be expressed as the quotient of two series which are both convergent for all values of the variable; the same is true of the functions

$$\sqrt{p\omega - \varepsilon_\lambda} \qquad (\lambda = 1, 2, 3).$$

It follows directly from Weierstrass's theorem that the σ-function may be expressed as a convergent series for all values of the variable.

The different series are calculated and it is interesting to compare the results usually obtained from the well-known theorem also due to Weierstrass, that *every one-valued function that has not an essential singularity in the finite portion of the plane, may be expressed through the quotient of two power-series, which are convergent for all values of the variable.*

Weierstrass's theorem is also generalized and applied to differential equations of a higher order.

Dynamical Trajectories: Dr. EDWARD KASNER, Columbia University, New York City.

Professor Kasner discusses two general questions, of interest in connection with celestial mechanics, relating to the geometry of dynamical trajectories. The first is suggested by the problem of binary stars and Bertrand's discussion of the interdependence of Kepler's laws. It is shown that two distinct fields of force can have only a certain multiplicity of trajectories in common. It is then possible to determine a field from a minimum number of trajectories. In particular, the Newtonian law may be deduced without assuming, as Bertrand does, that all the orbits are conics.

The second part of the paper relates to the problem of n bodies, and extends some of the results which hold for a single particle (see *Trans. Amer. Math. Soc.*, 1906, 1907). For example, the locus of the centers of the osculating spheres, under prescribed initial conditions, is a cubic curve; in the case of a single particle, on the other hand, it is a straight line. The results obtained are true for all interacting particles.

The Stream Function for a Straight Channel with a Circular Island: JAMES MCMAHON, Cornell University, Ithaca, N. Y.

This is one of the standing problems in two-dimensional fluid motion. A solution is here obtained by imagining a doublet placed mid-stream in a uniform current so that the line from the source to the adjoining sink points in the direction of the undisturbed current. The appropriate stream

function is determined to suit the boundary conditions, by the image-method; and it is shown that one of the stream lines breaks up into the median line of the channel and a symmetrical oval. The strength of the doublet can be so adjusted that this oval does not differ appreciably from a given circle when the latter does not occupy more than half the breadth of the channel.

Preliminary Wave-lengths of Flash Spectra taken in Spain, August 30, 1905: Dr. S. A. Mitchell, Columbia University, New York City.

The wave-lengths were obtained from photographs taken by the writer while a member of the United States Eclipse Expedition. The spectrograph was a four-inch grating of 14,438 lines per inch ruled on a parabolic surface, which was used without slit. Weather conditions were splendid. The photographs are remarkable for their splendid detail throughout their whole length from D_3 to 3,300. There are about five thousand measurable lines in this region. The dispersion of the grating is about the same as for the 'Bruce three' spectrograph of the Yerkes Observatory and the Mills spectrograph of the Lick Observatory, the distance from D_3 to H being seven inches.

On the Minimum Number of Operators whose Orders exceed Two in any Finite Group: Dr. G. A. Miller, University of Illinois, Urbana, Ill.

When just half of the operators of a group are of order 2 the order of the group is twice an odd number, and all the operators of odd order together with the identity constitute an abelian subgroup whose order is half the order of the group. Professor Miller's paper has for its main object the proof of the following theorems: If the order (g) of a group is written in the form

$$2^{\alpha_0} p_1^{\alpha_1} p_2^{\alpha_2} \cdots p_\lambda^{\alpha_\lambda},$$

$p_1, p_2, \ldots, p\lambda$ being distinct odd prime numbers and $\alpha_0 > 0$, the number of the operators whose orders exceed 2 can not be less than

$$\frac{(p_1^{\alpha_1} p_2^{\alpha_2} \cdots p_\lambda^{\alpha_\lambda} - 1) g}{2 p_1^{\alpha_1} p_2^{\alpha_2} \cdots p_\lambda^{\alpha_\lambda}}.$$

Moreover, it is possible to construct a group in which the number of operators whose orders exceed 2 is exactly equal to this number. If a group of order g contains the smallest possible number of operators whose orders exceed 2, the sub-group which is composed of all its operators which are commutative with one of the non-invariant operators of order 2 contains no operator whose order exceeds 2. This sub-group is a Sylow sub-group and just half of the remaining operators are of order 2.

Results of Physical Observations on the Saturnian System with the 18-inch Clark Refractor: Professor David Todd, Amherst College, Amherst, Mass. (Presented by title.)

With the exception of those papers which appear upon the joint program of Friday morning, as given above, the papers of Section A were presented in connection with the program either of the Mathematical or of the Astronomical Society, according to the subject matter treated in each case. This arrangement was made in accordance with a resolution adopted at the Ithaca meeting to the effect that 'the sectional committee be empowered to turn over technical papers to the technical societies.'

Laenas Gifford Weld,
Secretary

THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA

II

A New Form of Meridian Mark: G. W. Hough.

Two years ago I established a meridian mark in order to study the change of azi-